

## SUBSTITUTE SPECIFICATION FOR U.S. APPLICATION

**Inventors:** Karel van den Berg et al

**Title:** AN IMPLEMENT FOR AUTOMATICALLY DETACHING AND DISPLACING AN AMOUNT OF FEED, SUCH AS, FOR EXAMPLE, SILAGE OR HAY

### **FIELD OF THE INVENTION:**

The invention relates to an apparatus for automatically detaching and displacing an amount of feed, such as for example silage or hay, from a stock of feed, said apparatus being provided with a robot arm with a detaching member which is suitable for detaching a part of the feed from the stock, displacing it to a predetermined place and depositing it there. Such an apparatus has the advantage that, in a simple manner, a measured out amount of feed, in particular fodder that is difficult to handle, such as silage or hay, can be detached from a stock of feed and be displaced to a predetermined place. In particular in relation to known constructions, in which for example an auger is used, the above-mentioned apparatus has the advantage that with the aid of the robot arm various stocks of feed can simply be reached by the robot arm with the detaching member.

### **SUMMARY OF THE INVENTION:**

The detaching member according to the invention comprises a gripping element which has the advantage of being less sensitive to clogging, and has the further advantage of making it possible for example to detach a tuft of hay from a bale of hay.

In a preferred embodiment of the invention, the detaching member comprises a bucket or a shovel. By means of the bucket or the shovel it is in particular possible to detach in a simple manner blocks of concentrate from a stock of feed.

According to another inventive feature, the detaching member is capable of being closed. Especially when granular or pulverulent material has to be detached from a stock of feed, it is of importance that the detaching member can be closed for the purpose of preventing loss of feed during transport.

In order to prevent the detaching member from being contaminated, the robot arm is provided with cleaning or brushing means, or both, for the detaching member. In a preferred embodiment of the invention, the cleaning or brushing means, or both, comprise a sweeping element. For the purpose of being able to detach from the stock a previously measured out portion of feed, the apparatus comprises metering means.

According to again another inventive feature, the apparatus comprises weighing means for weighing said portion of feed. According to a further inventive feature, the robot arm comprises the weighing means. In order to be able to determine where and when a particular amount of feed can be deposited by the robot arm with the detaching member, the apparatus comprises animal identification means, with the aid of which an animal can be identified. According to a further inventive feature, the animal identification means are fitted on the robot arm. This has the advantage that, for example in the situation that a feeding column with various feeding troughs is used, it is not necessary to provide each feeding trough with animal identification means.

According to a further inventive feature, the apparatus comprises at least one trough for feeding or watering, or both. According to another inventive feature, the apparatus comprises at least one container for storing the fodder or drink, or both. In a preferred embodiment of the invention, the robot arm is disposed above the trough which is for feeding or watering, or both, and above the container. According to again another inventive feature, the apparatus is provided with a chute via which the feed can be discharged to a relevant feeding or watering trough, or

both. In an embodiment of the invention, the robot arm has such dimensions that the detaching member can move over or along the bottom of the container or the feeding or watering trough or any combination thereof. Thus it is possible to take the last remnants of feed from the container or the trough. In order to be able also to use the robot arm for example in a loose house, the robot arm is at least movable over the floor of the stable. In a preferred embodiment of the invention, the robot arm is movable along a rail. It will be obvious that it is also possible to dispose the robot arm for example on belts, such as caterpillar tracks, and to move it in this manner through the stable. According to again another embodiment of the invention, the apparatus comprises one or more transport vehicles that co-operate with the robot arm. Thus it is possible, for example in a stable, to convey by means of the transport vehicles the feed that has been detached to a particular place and to deposit it there. In a preferred embodiment of the invention the transport vehicles are movable along a rail. The above-mentioned apparatus can in particular be applied in a feeding column with various feeding or watering troughs, or both, to which the animals are allowed to go.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be explained in further detail with reference to the accompanying drawings, in which:

Figure 1 is an elevational cross-sectional view of an apparatus according to the invention;

Figure 2 is a second embodiment of an apparatus according to the invention; and

Figure 3 is a plan view of a loose house in which a third embodiment of an apparatus according to the invention is depicted.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 is a cross-section of an apparatus 1 for automatically detaching and displacing an amount of feed. Apparatus 1 is provided with a robot arm 2 with a detaching member 3 which is suitable for detaching feed from containers 4 that are integrated in a feeding column 5. Feeding column 5 comprises troughs 7 for feeding or watering, or both, that are disposed around a central axle 6 and from which animals, such as cows for example, can eat or drink, or both. Each feeding trough 7 is capable of being closed separately by means of a closing member 8 which is a lid in the present embodiment. Under each feeding trough 7 is disposed a load cell 9 with the aid of which the weight of a relevant feeding trough can be determined. As shown in Figure 1, the robot arm is arranged centrally above containers 4. This measure has the advantage that robot arm 2 with detaching member 4 can reach in a simple manner all containers 4, as well as feeding troughs 7. Robot arm 2 is also provided with a weighing device 10 which is designed as a load cell in the present embodiment. By means of weighing device 10 it is possible to determine each time how much feed is taken from a container 4 and deposited in a particular feeding trough 7. Robot arm 2 is further provided with a first stepper motor 11 with the aid of which robot arm 2 can be rotated about a vertical axle 12. Robot arm 2 is further provided with two further stepper motors 13 with the aid of which robot 2 arm can be positioned in the vertical plane. The end of robot arm 2 comprises a telescopic piston and cylinder unit 14. In the present embodiment detaching member 3 is designed as a gripper 15 with the aid of which feed can be seized and be released. Near detaching member 3 there is further disposed an animal identification system 16 which makes it possible to recognize an animal that is standing near one of troughs 7. By means of the animal identification system 16 and a computer it can thus be determined whether or not an animal that is waiting near a feeding trough 7 will be fed. Upon feeding the animals it is possible to compose a meal of feed from various containers 4 for a

relevant animal. The gripper is particularly appropriate when roughage, such as for example silage or hay, has to be taken from a container 4. It will be obvious that it is also possible, of course, when remnants of feed are still present in feeding troughs 7 after a particular animal has eaten there, to take these remnants back by means of robot arm 2, and to displace them to a relevant container 4 and deposit them there.

Figure 2 shows a second embodiment of an apparatus 1 for automatically detaching and displacing an amount of feed from a container 4 of a feeding column 5 which is not completely depicted in Figure 2. In the present embodiment robot arm 2 is differently designed than robot arm 2 according to Figure 1. However, corresponding parts are indicated by the same reference numerals. By means of upper stepper motor 13 it is possible to move detaching member 3 along the curved lines of container 4, while the lower stepper motor 13 makes it possible to move the entire robot arm 2 upwardly or downwardly. To allow the latter movements, robot arm 2 comprises a quadrangular pivot construction 17. In the present embodiment detaching member 3 comprises a bucket 18 which is disposed at the end of robot arm 2. With the aid of bucket 18 feed can be scooped from container 4. By means of a closing mechanism 19 it is possible to close bucket 18 after the latter has been filled completely, so that feed is prevented from falling from the bucket during transport. For that purpose closing mechanism 19 comprises a closing lid 20 which is connected by means of a steering rod 21 to a stepper motor 22 which, after having been energized, causes bucket 18 to be closed or opened. Closing mechanism 19 is further coupled with cleaning means 23 that is moved along the bottom or along the walls of bucket 18 or both during opening or closing or both of said bucket 18. For that purpose cleaning means 23 comprise a brushing element 24. When bucket 18 has been filled completely, said bucket 18 is moved by means of robot arm 2 to a chute 25 where the feed is poured into chute 25 by activating closing mechanism 19. Via chute 25 the feed is poured into a predetermined feeding

trough, such as feeding trough 7 in Figure 1. By means of torque measurements on the stepper motors 11 or 13, or both, it is possible to determine whether the bucket is full or empty while removing feed from containers 4. Apparatus according to figure 2 can be completely integrated into feeding column 5 as shown in Figure 1.

Figure 3 is a plan view of a stable 26 with a third embodiment of an apparatus 1 according to the invention arranged therein. Stable 26 comprises two rows of feed stands of cubicles 27 and at the end thereof two storage areas 28 for storing roughage or concentrate, or both. Storage areas 28 each comprise a plurality of containers 4 for storing various categories of fodder or drink, or both. A rail 29 is disposed between the two rows of feed stands 27 and storage areas 28 along which a transport vehicle 30 moves automatically under computer-control. By means of robot arm 2, feed can be deposited from a container 4 into transport vehicle 30 by means of detaching member 3. Robot arm 2 of apparatus 1 in Figure 1 may be designed as the robot arm in Figure 1 or Figure 2. Robot arm 2 is also automatically movable under computer-control along the rail 29. With the aid of animal identification means it is thus possible to convey feed to a predetermined feed stand of a cubicle 27 by means of robot arm 2 and transport vehicle 30. It is also possible to arrange a stationary robot arm 2 between storage areas 28 and to convey feed to a particular place only by means of transport vehicle 30.

Although we have disclosed the preferred embodiments of our invention, it is to be understood that it is capable of other adaptations and modifications within the scope of the following claims: